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GB A 2058645 **GB 1536603**
GB A 2048753

(58) Field of search
B4C
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(54) Hammer drill

(57) A hammer drill with a motor-driven air-cushion percussion mechanism 4 is proposed, and in this there is arranged between the drive motor 2 and the drive member 16, 27, 30, 31 of the percussion mechanism 4 a releasable coupling 39, (69), (87), which couples a gear assembly, driven by the motor 2, to the drive member 16, 27, 30, 31 for transmitting drive to the drive member in response to a drill tool 9 being pressed against a workpiece. Arranged between the inserted tool (9) and the movable coupling part (39, 69, 87) are movement-transmitting members, at least one (52, 80, 91) of which is designed and or arranged in such a way that the effect on the movable coupling part (39, 69, 87) of the pressing force exerted on the tool (9) is intensified. The intensification effect is the cause of the mechanical advantage attained due to the arrangement of the member 52.

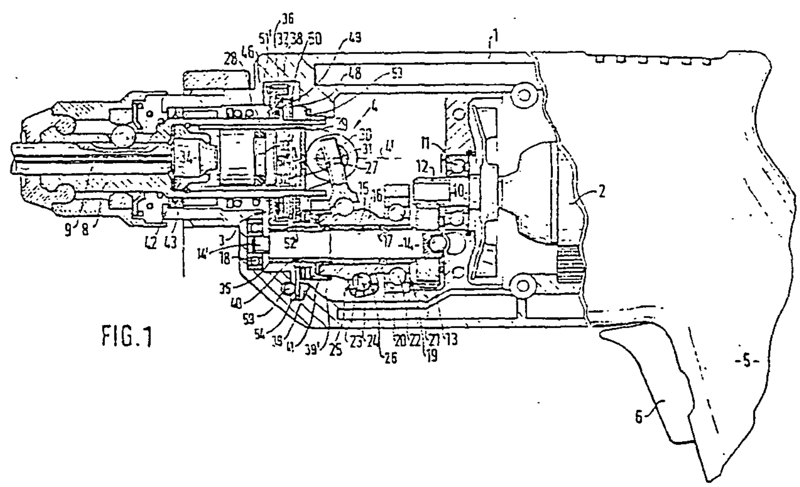

FIG.1

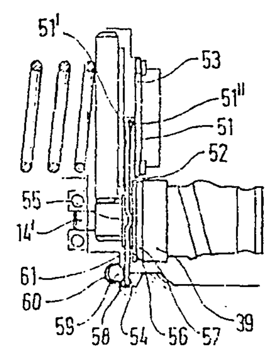

FIG. 2

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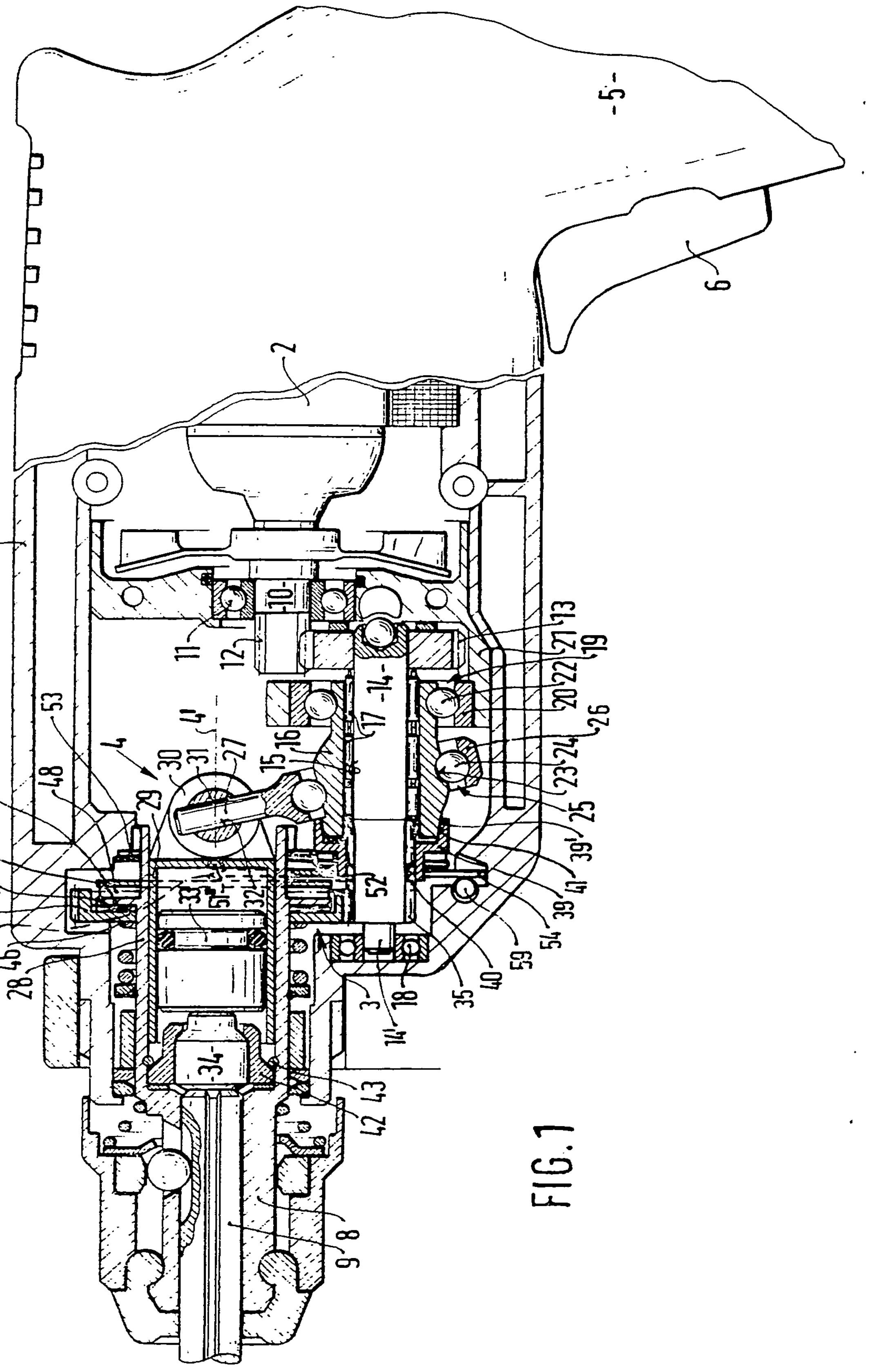

FIG.1

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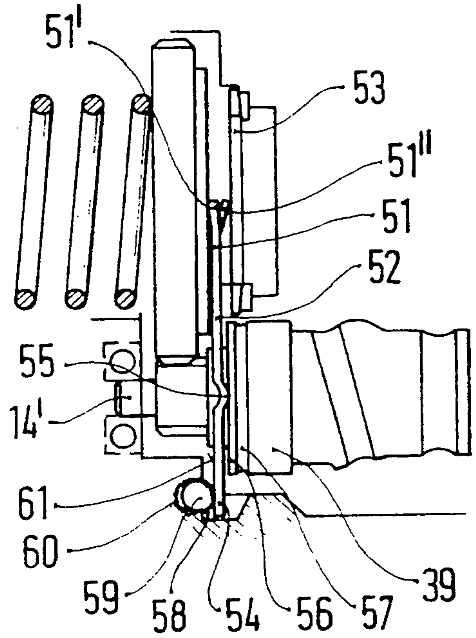

FIG. 2

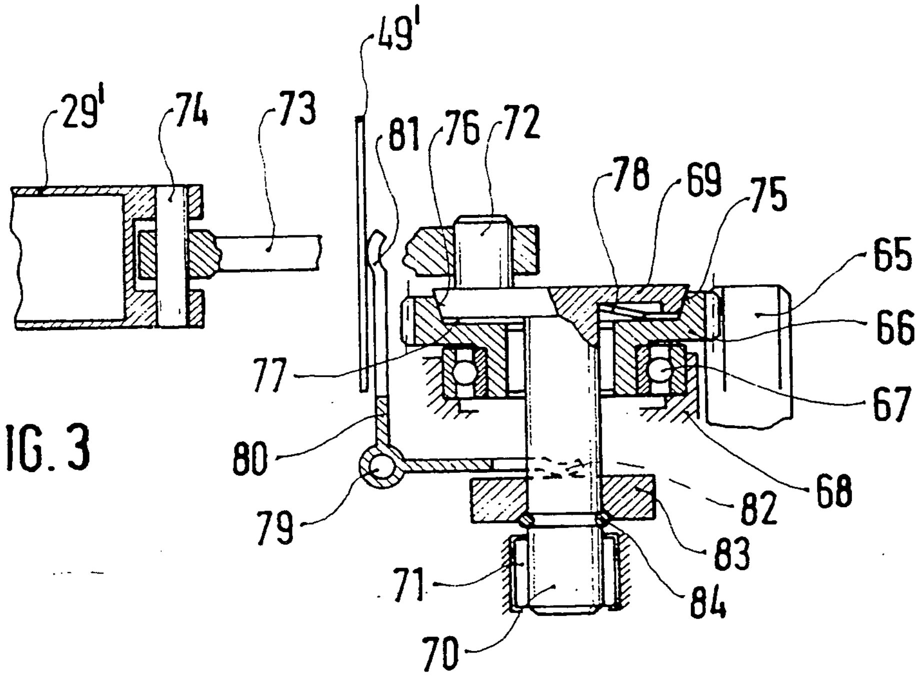

FIG. 3

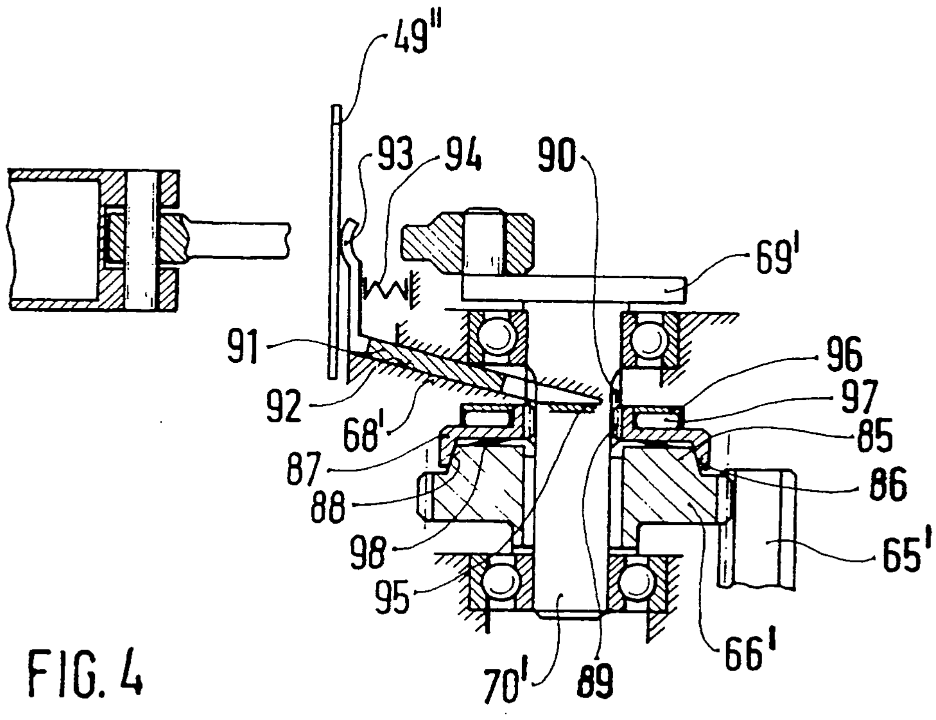

FIG. 4

SPECIFICATION

Hammer drill

State of the art

The invention starts from a hammer drill according to the pre-characterising clause of the main claim. Such a hammer drill is already known from German Patent Specification 2,449,191. In this known hammer drill, the effectiveness of the releasable coupling between the electric motor and the drive member of the percussion mechanism depends on the pressing force which is exerted by the person operating the drill. Apart from the fact that this makes it more difficult to operate the drill, a reliable take-up of the drive member of the percussion mechanism depends on particular individual circumstances, since not every user of the drill can exert the same pressing force.

Advantages of the invention

In contrast to this, the advantage of the hammer drill according to the invention, which has the characterising features of the main claim, is that the pressing force which the person operating the drill requires for percussion drilling is extremely low, but that the closing force actually acting on the coupling is greater than in conventional hammer drills corresponding to the state of the art, when the same pressing force is exerted.

As a result of the measures listed in the subclaims, advantageous developments and improvements of the hammer drill indicated in the main claim are possible. It is particularly advantageous if at least one of the members for transmitting movement is designed as part of a lever system. A construction which is of simple design and is economical in terms of parts and space required can be achieved in this way.

Depending on the design of at least one of the members for movement transmission, the arrangement according to the invention can be used both in conjunction with those percussion mechanisms, the drive of which is derived from a drive shaft extending parallel to the axis of the percussion mechanism, and in conjunction with those having a drive shaft which extends at an angle relative to the axis of the percussion mechanism.

An especially advantageous embodiment also emerges from Claim 9, according to which at least one of the members for movement transmission is designed so that the effect on the movable coupling part of the pressing force exerted on the tool does not exceed a predetermined amount, irrespective of the intensity of the pressing force. This makes it possible to achieve the best possible coupling effect largely independent of the particular pressing force exerted on the hammer drill.

Drawing

Three exemplary embodiments of the invention are illustrated in the drawing and explained in more detail in the following description. *Figure 1* illustrates a first exemplary embodiment of a hammer drill shown in a side view and partially in section, *Figure 2* illustrates a portion cut out from Figure 1 in a side view, and *Figures 3* and *4* illustrate further exemplary embodiments shown in side views in the form of a portion cut out from a hammer drill.

Description of the exemplary embodiments

The hammer drill illustrated in Figure 1 of the drawing has a housing 1, in which an electric motor 2, a gear 3 and a percussion mechanism 4 are arranged. The axis 4' of the percussion mechanism is parallel to the axis of the electric motor 2. The housing 1 at its rear end merges into a handle 5. Installed in the latter is a switch which is provided with a trigger 6 and by means of which the electric motor 2 can be started. At the lower end of the handle 5, a power feed cable is introduced through an elastic bush. A toolholder 8 which serves for receiving tools, such as, for example, the drill bit 9, is arranged on the housing 1 at the front end facing away from the handle 5.

The electric motor 2 has a drive shaft 10 which is mounted on both sides in ball bearings fastened in the housing 1. The end of the drive shaft 10 mounted in the ball bearing 11 carries a motor pinion 12 which engages into a gear wheel 13. The latter is pressed onto an intermediate shaft 14 which passes through an axial bore 15 in a drum 16. Arranged in the axial bore 15 are needle cages 17, in which the intermediate shaft 14 is mounted. The end 14' of the intermediate shaft 14 facing away from the electric motor 2 is mounted in a bearing 18 integral with the housing.

The drum 16 is mounted in the housing 1 via a ball bearing 19. The outer ring 20 of the ball bearing 19 is located as a fixed bearing in the housing part 21. The inner race for the balls 22 of the ball bearing 19 is formed by the drum 16 itself. The drum 16 also has a track 23 having an axis oblique relative to the axis of the intermediate shaft 14. The track 23 forms the inner race for balls 24 which are parts of a ball bearing 25, the outer ring of which is designed as a swash plate 26. A finger 27 formed on the swash plate 26 drives the percussion mechanism 4.

The percussion mechanism 4 is arranged inside a guide tube 28 which is mounted rotatably in the housing 1 and which, in the exemplary embodiment illustrated, is made in one piece with the tool holder 8. A position 29 serving as a drive member is guided in a sealed manner and so as to slide in the guide tube 28. The rear end 30 of the piston 29 facing away from the toolholder 8 is made fork-like and carries a pivot pin 31. The latter has a transverse bore 32, into which the finger 27 engages with play. As a result, the finger 27 can move easily in the transverse bore 32 in the axial direction. Guided in a sealed manner and so as to slide in the hollow piston 29 is a striker 33 which via a header 34 acts on the rear shank end of the tool 9.

The intermediate shaft 14 has over some of its total length a pinion-like toothing 35 which engages into a gear wheel 36. The latter is mounted on the guide tube 28 so as to be displaceable and freely rotatable. It comes under the influence of the compression spring 46 which endeavours constantly

to press the gear wheel 36 against a collar 50 of the guide tube 28. The end faces of the gear wheel 36 on the one hand and of the collar 50 which face one another have projections 37, 38 which are designed so that, when they interact, they serve as a take-up coupling and, under the influence of the compression spring 46, as an overload coupling. Located on the part of the intermediate shaft 14 provided with a toothing 35 is a sleeve 39 which has an inner toothing 40 matching the toothing 35 and which is displaceable on the intermediate shaft 14. The edge 39' of the pot-shaped sleeve 39 is made conical on its inner wall and is intended for interacting with an outer cone 41 arranged on the drum 16. The sleeve 39 and the outer cone 41 thus constitute a cone coupling (39/41), by means of which the drum 16 can be connected fixedly in terms of rotation to the intermediate shaft 14. The cone coupling 39/41 is engaged under the influence of the guide tube 28 which is shifted axially as a result of the pressure of the drill bit 9 against the workpiece to be treated.

The rear shank end of the drill bit 9 thereby presses against the header 34 held with a relatively slight axial play of movement in a sleeve 42 which itself, secured by a ring 43, is mounted in the guide tube 28. The pressure of the shank end of the drill bit 9 on the header 34 causes the toolholder 8 together with its guide tube 28 to be shifted axially via the sleeve 42 and the ring 43. The collar 50 of the guide tube 28 thereby presses via an axial bearing 48 and a disc 49 against the fork-like end 51, engaging round the guide tube 28, of a lever 52. Two tabs 51' and 51" are formed at the fork-like end 51 of the lever 52, and of these the tab 51' is inclined towards the disc 49 and the tab 51" is inclined towards a cup spring 53. The end 54 located opposite the fork-like end 51 of the lever 52 is likewise made fork-like and engages round the intermediate shaft 14 and the taper sleeve 39 mounted on it. At the height of the axis of the intermediate shaft 14, the lever 52 has, at each of its fork-like ends 54, a projection 55 which is supported against the taper sleeve 39 via a disc 56 and an axial bearing 57. Arranged near a recess 58 in the housing 1 is an eccentric pin 59 which is rotatable about its bearing axis and which is consequently adjustable. As shown in Figure 2, the eccentric pin 59 can have, in its region mounted in the housing 1, a knurl-like toothing 60 which, interacting with its bearing bores in the housing 1, prevents it from rotating inadvertently.

In the exemplary embodiment according to Figures 1 and 2, the lever 52 is inserted loosely in the housing 1, specifically in such a way that its lower end 54 projects into the housing recess 58 and is supported there against the housing 1. During the time when the projection 55 rests against the end face of the disc 56, the surface 61, facing away from the projection 55, of the lower end 54 of the lever 52 is supported against the periphery of the eccentric pin 59.

When the guide tube 28 and consequently the axial bearing 48 and disc 49 are shifted as a result of the pressure of the tool 9 inserted in the hammer drill against the workpiece to be treated, the end face of the disc 49 presses against the tab 51' of the upper end 51 of the lever 52, with the result that the latter, since its lower end 54 cannot move aside because its surface 61 comes up against the periphery of the eccentric pin 59, is pivoted in the direction of the cone coupling 39/41. The projection 55 thereby presses against the end face of the disc 56, with the result that the taper sleeve 39 makes via the axial bearing 57 a coupling connection with the outer cone 41 formed on the drum 16. The lever 52 is made of resiliently flexible material, so that, if the pressing force is possibly intensified further by the person operating the hammer drill, further displacement of the guide tube 28 can take place, but the effective force acting on the coupling parts 39, 41 does not exceed a predetermined value. The cup spring 53 is designed as regards its spring force so that it allows the above-described pivoting movements of the lever 52 to take place unimpeded. It merely serves, when the pressing force decreases, to pivot the lever 52 back into the position, in which the coupling 39/41 is released, and, when the hammer drill is used with the tool directed vertically upwards, to prevent the coupling 39/41 from being closed simply as a result of the dead weight of the parts acting on the lever 52 and consequently prevent the percussion mechanism from starting to operate even during no-load operation.

The effect of the pressing force exerted on the tool 9 on the taper sleeve 39 is intensified, and it is evident that the effective intensification effect depends on the ratio between the distance of the projection 55 and the distance of the tab 51' touching the disc 49 and located on the lever 52 from the pivot point of the latter.

It is possible by adjusting the eccentric pin 59 to compensate possible production tolerances in a simple way. Of course, if this possibility of adjustment is relinquished, the lever 52 can be mounted on a pivot axle arranged in the housing 1. Figure 3 illustrates diagramatically an exemplary embodiment of the invention, in which the percussion mechanism is driven via a crank mechanism. 65 designates a drive pinion which is located on the shaft of the drive motor (not shown) or which is connected by gearing to this. The pinion 65 engages into a gear wheel 66 which is mounted in a housing 68 via a ball bearing 67. A crank disc 69 is located on a journal 70 which is connected in one piece to it and which is mounted displaceably in the housing 68 in a needle bearing 71. The crank disc 69 carries a crank pin 72 arranged eccentrically relative to axis of the former. This crank pin 72 projects into a bore in a connecting rod 73. At its other end, the connecting rod 73 receives a piston pin 74 which is arranged in the fork-like end of a piston 29'. The piston 29' corresponds to the piston 29 in the exemplary embodiment according to Figure 1 and performs exactly the same function as this within the percussion mechanism 4.

The crank disk 69 has on its periphery a cone 75 which, together with an inner cone 76 in a notch 77 of the gear wheel 66, constitutes an engageable and disengageable take-up coupling. A cup spring 78 inserted into the notch 77 endeavours constantly to press the crank disc 69 away from the gear wheel 66

and thus always keep the coupling 75 76 in the released position.

A two-armed lever 80 is mounted pivotably about a pin 79 fastened in a housing 68. Its two arms 81, 82 are fork-like. The lever arm 81 is intended to interact with a disc 49' and the lever arm 82 to interact with a disc 83. The disc 49' corresponds to the disc 49 in the exemplary embodiment according to Figure 1. The further parts interacting with the disc 49' are likewise identical to those in the exemplary embodiment according to Figure 1 and are therefore omitted in Figure 3 for the sake of greater clarity. Here again, the disc 49' is moved counter to the direction of advance of the drilling tool when the latter is pressed against the workpiece to be treated. The disc 49' pressing against the lever arm 81 thereby pivots the lever 80 about the pin 79, with the result that the lever arm 82 presses against the disc 83. Since the latter is secured by the ring 84 on the journal 70, it takes up the latter and consequently the crank disk 69 and moves them against the force of the cup spring 78. The coupling 75/76 is engaged, so that the crank disc 69 is driven by the rotating gear wheel 66. The rotary movement is converted in a known way into a to-and-fro movement of the piston 29' via the crank pin 72, the connecting rod 73 and the piston pin 74.

In this exemplary embodiment again, the pressing force exerted on the tool and in the end acting on the movable coupling part is intensified as a result of an appropriate design of a transmission member, in this case the lever 80, the more so, the longer the lever arm 81 in comparison with the length of the lever arm 82. Here again, at least one of the lever arms 81, 82 can be designed or constituted so that, after predetermined pressing force has been reached in the region of the coupling itself, a further intensification of the pressing force exerted on the tool results in no or only an insignificant increase in pressure exerted in the coupling region.

In the exemplary embodiment according to Figure 4, a wedge gear is used instead of a pivoting-lever gear. The design, not evident from the drawing, of the drive device and of the movement converting device corresponds essentially to that of the exemplary embodiment according to Figure 3. A drive pinion 65' engages into a gear wheel 66' which is mounted rotatably on the journal 70' of a crank disc 69'. The gear wheel 66' has an extension 85, on which an outer cone 86 is formed. A sleeve 87 with an inner cone 88 is mounted displaceably on the journal 70' of the crank disc 69'. Intermeshing teeth 89, 90 ensure a constant rotary take-up connection between the journal 70' and the sleeve 87 displaceable on it. A slide 91 is guided in a guide groove 92 formed in the housing 68'. The latter extends obliquely relative to the axis of the journal 70'. The slide 91 has an angled fork-like arm 93 which is supported against the disc 49" under the effect of a spring 94. The end of the slide 91 facing the journal 70' is likewise made fork-like. It engages round the journal 70' and by means of a bevelled edge 95 comes up against a disc 96 which rests on the sleeve 87, with sliding rollers 97 being interposed.

In this exemplary embodiment again, as a result of the pressure of the tool against the workpiece to be treated, the disc 49" is shifted to the right. Because the arm 93 comes up against the disc 49", the slide 91 also participates in this movement. As a result of the oblique guide groove 92, this shifting movement is associated with a certain wedge effect on the disc 96 and therefore on the sleeve 87. The sleeve 87 is thereby moved towards the gear wheel 66', until the cone 88 presses against the cone 86. This ensures the rotary take-up between the gear wheel 66' and the journal 70' and consequently the crank disc 69. As soon as the pressure exerted on the tool decreases, the disc 49" returns to its initial position again. Under the influence of the spring 94, the arm 93 and consequently the slide 91 follow it. A cup spring 98 arranged between the gear wheel 66' and the sleeve 87 ensures the release of the coupling connection 86/88. The drive to the percussion mechanism is disconnected again. The arm 93 can be designed or constituted in such a way that, after a predetermined pressing force has been reached in the region of the coupling connection 86/88, it yields resiliently when the pressing force exerted on the tool is further intensified.

CLAIMS

1. Hammer drill with a motor-driven percussion mechanism, in which a drive member moved to and fro acts via an air cushion on an axially movable striker which delivers its energy to a tool guided in the hammer drill, the drive member of the percussion mechanism being moved by an electric motor via a gear containing a movement converter for converting the rotary movement of the electric motor into the to-and-fro movement of the drive member of the percussion mechanism, and there being arranged in the gear train between the electric motor and the drive member of the percussion mechanism a releasable coupling which is brought into the active position and held there as a function of the pressure of the tool against the workpiece to be treated, characterised in that there are arranged between the tool (9) inserted in the hammer drill and the movable coupling part (39, 69, 87) movement-transmitting members, at least one (52, 80, 91) of which is designed and/or arranged in such a way that the effect on the movable coupling part (39, 69, 87) of the pressing force exerted on the tool (9) is intensified.

2. Hammer drill according to Claim 1, characterised in that at least one (52, 80, 91) of the movement-transmitting members is designed as part of a lever system.

3. Hammer drill according to one of Claims 1 or 2, characterised in that at least one of the movement-transmitting members is designed as a one-armed lever (52).

4. Hammer drill according to Claim 3, characterised in that the lever (52) is mounted pivotably in the housing (1) of the hammer drill.

5. Hammer drill according to one of Claims 1 or 2, characterised in that at least one of the movement-transmitting members is designed as an angle lever (80) mounted pivotably in the housing.

6. Hammer drill according to Claim 1, characterised in that at least one of the movement-transmitting members is designed as part (91) of a wedge gear.

7. Hammer drill according to Claim 4, characterised in that the lever (52) is supported, near its end (54) facing away from the axis of the tool holder (8), against an eccentric pin (59) rotatable about its bearing axis.

8. Hammer drill according to Claim 7, characterised in that the eccentric pin (59) has, in its region mounted in the housing (1), a knurl-like toothing (60) which, interacting with its bearing bores in the housing (1), prevents it from rotating inadvertently.

9. Hammer drill according to one of Claims 1 to 8, characterised in that at least one (52, 80, 91) of the movement-transmitting members is designed so that the effect of the pressing force exerted on the tool (9) on the movable coupling part (39, 69, 87) does not exceed a predetermined amount, irrespective of the intensity of the pressing force.

10. Hammer drill according to Claim 9, characterised in that at least one (52, 80, 91) of the movement-transmitting members is designed as a resiliently flexible lever of predetermined inherent rigidity.

11. Hammer drill according to one of Claims 1 to 10, characterised in that at least one of the movement-transmitting members is under the influence of at least one spring (53, 78, 94, 98) which acts to release the coupling and the force of which is such that the dead weight of the toolholder (8) and of the movement-transmitting members connected operatively to the latter is not sufficient to move the movable coupling part (39, 69, 87) into the coupling position during no-load operation and when the tool axis is directed upwards.

12. Hammer drill according to one of Claims 1 to 11, characterised in that at least one (52, 80, 91) of the movement-transmitting members is made fork-like.

13. A hammer drill substantially as herein described with reference to Figures 1 and 2, Figure 3, or Figure 4 of the accompanying drawings.

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